THELANCET-D-16-00992 R2
[PII_REPLACE]
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16TL0992
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This version saved: 09:58, 20-Feb-18

Lancet NCD health economics action 4

Equity impacts of price policies to promote healthy behaviours

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Governments can use fiscal policies or regulation to influence the prices of products and thereby change their consumption, with potential health effects in the population. However, policies aimed at reducing consumption by increasing prices, for example by taxation, might impose an unfair financial burden on low-income households. We used data from household expenditure surveys to estimate patterns of expenditure on potentially unhealthy products by socioeconomic status, with a primary focus on low-income and middle-income countries. Price policies affected the consumption and expenditure of high-income households more than low-income households, and any resulting price increases tended to be financed disproportionately by high-income households. As a share of all household consumption, however, price increases were often a larger burden for low-income households, most consistently in the case of tobacco, depending on how much consumption decreases in response to increased prices. Large health benefits often accrue to individual low-income consumers because of their strong response to price changes. In the case of taxes, a potentially larger financial burden on low-income households could be mitigated by a pro-poor use of the generated tax revenues.

This is the fourth in a **Series** of five papers about economics and non-communicable diseases

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What are price policies for health promotion, and is their use justified?

The framework for addressing the growing global epidemic of non-communicable diseases (NCDs) was adopted at the 2011 high-level meeting of the UN General Assembly.[1] Four leading behavioural risk factors for NCDs were identified in the framework wereNCDs tobacco use, harmful alcohol consumption, poor diet, and insufficient physical activity. At least three of these risk factors involve the consumption of products purchased in markets that national governments regulate to varying degrees. Through regulation and fiscal policies (both taxes and subsidies), governments can affect market prices and turn them into behavioural incentives for health improvement. In the pursuit of the Sustainable Development Goal target to reduce mortality from NCDs, attention is turning to policies that can help achieve the target, as well as to the means that are necessary to finance the prevention and control of NCDs. Price policies, particularly increased taxes on tobacco and other potentially unhealthy products, could support both.

Addressing tobacco and harmful alcohol use and improving diet would reduce the prevalence of the most prominent lethal NCDs, such as cardiovascular disease, stroke, cancer, and chronic respiratory diseases, and of injuries and alcohol-use disorders. In most countries, these diseases affect the poor disproportionately.[2] Population-level interventions to address those risks have generally been more cost-effective than medical interventions to treat diseases.[3–6]

Taxes on tobacco and alcohol are key components of the Framework Convention on Tobacco Control and of WHO's Global Strategy on Tackling Harmful Alcohol Use.[7,8] Taxes on food and non-alcoholic beverages have been adopted at the national or local level in many countries as part of efforts to improve nutrition and prevent obesity (target populations include susceptible groups [A: please can you clarify this statement in parentheses?]).[9,10] Calls are being made to extend the use of taxes in this area because, for example, increased prices of fast foods and reduced fruit and vegetable prices are associated with a reduced bodyweight in young and in low-income consumers, respectively.[11]

Key messages

- Price policies on potentially unhealthy products alter consumption and expenditure for all consumers, but the effects can differ by socioeconomic status
- Expenditure on potentially unhealthy products increases more for high-income than for low-income households in response to a price increase, but this change in expenditures is often a heavier burden for low-income households than for high-income households because it constitutes a higher share of their overall expenditure; this is particularly true for tobacco products
- Large health benefits are likely to accrue to individual low-income consumers because they generally have the strongest response to price changes
- Whether taxation is regressive depends on how this characteristic is defined; different measures might lead to different policy conclusions (most notably in the case of alcohol), and policy makers must be aware of such differences
- Adverse equity effects of taxes can be mitigated by a pro-poor use of the tax revenues generated or by adjustments in the distributional effects of the broader tax system

In addition to using fiscal policies, many countries have tried to regulate the minimum price of alcohol and tobacco products and used price promotions to increase sales **[A: increased sales of fruits and veg? You might wish to include an example of this as you have for alcohol]**. A 10% increase in the minimum price of alcohol in Canada has been estimated to reduce acute alcohol-attributable hospital admissions and chronic alcohol-attributable admissions 2 years later, both by about 9%.[12]

Taxes are also an important source of revenue. Tobacco taxes were described in the Addis Ababa Financing for Development outcome document[13] as offering "a revenue stream for financing for development in many countries". Data from the Organisation for Economic Co-operation and Development (OECD) show that in 2015, tobacco and alcohol excise taxes contributed to about 1·2–1·7% of total tax revenues in Argentina, Denmark, and Belgium, to about 3·3% of total tax revenues in the UK and Hungary, and to more than 9·5% of total tax revenues in Venezuela. In Denmark, tax on saturated fat content in foods accounted for 0·14% of total tax revenues between 2011 and 2012. A recent WHO estimate showed that increasing cigarette taxes by 50% in low-income countries like Congo **[A: Congo (Brazzaville)?]**, Laos, Vietnam, or Madagascar would generate additional revenues equivalent to more than 25% of current government expenditure on health. Increasing taxes on alcohol to 40% of beverage retail prices would have at least as large effects.[14]

See Online for appendix

In theory, price policies interfere with the functioning of markets and with individual choice, but they can be justified when markets do not function efficiently. This is typically the case, for example, when consumers do not bear the full cost of their choices because the market prices of the products they consume do not reflect harms to others (eg, from second-hand smoking, alcohol-related traffic accidents, or violence) or the extra health-care costs borne collectively,[15–17] so the consumption of those products tends to be higher than socially desirable. The addictive properties of some products and the influence of commercial advertising increase consumption further.

Evidence that consumers respond to price incentives justifies the expectation that price policies will generate beneficial health effects. However, the equity effects of price policies have been a concern for many governments. Expenditures due to increased prices are widely perceived to weigh most heavily on the incomes of people of low socioeconomic status, although the same people might also benefit more than others in health terms **[A: would it be possible to provide a reference to support this statement?]**.

We have assessed the existing evidence and household survey data on the equity effects of price policies on potentially unhealthy products. Here we discuss the equity effects in terms of both their financial and health consequences on individuals and households in countries at different levels of income. In the final section, we bring together different sets of findings to help policy makers decide whether concerns about the equity effects of price policies are a legitimate barrier to the use of these policies in the pursuit of health goals. Many of the examples presented in this Series paper are based on taxes because they are most commonly used, but our analyses and conclusions are applicable to a broad range of price policies, such as subsidies or price regulation.

Socioeconomic patterns of potentially unhealthy consumption

We start by considering how consumption differs between groups with different socioeconomic status to gauge the likely effects of price policies. We assessed patterns of consumption by socioeconomic status for four aggregates of products: tobacco products (hereinafter tobacco); alcoholic beverages (alcohol); non-alcoholic beverages, excluding water (soft drinks); and snacks and confectionery products (snacks). These aggregates differ slightly between countries in terms of the products they contain. A complete set of definitions is provided in the appendix. Socioeconomic status is a function of income or total (expenditure-based) household consumption, depending on data availability (hereinafter income, for ease of reference). Results presented in this Series paper are primarily in the form of top-to-bottom quintile ratios (ie, as ratios between the average value of the relevant outcome in the top quintile and the average value in the bottom quintile). Results for individual quintiles are fully reported in the appendix, and they show that in a few countries, the relevant outcomes are not uniformly increasing or decreasing across groups with different socioeconomic status, which should be considered when interpreting top-to-bottom quintile ratios.

The countries included in the analysis were selected on the basis of the availability of good quality data from relatively recent expenditure surveys (undertaken in or after 2000). These countries provide wide geographical coverage in the following regions: Latin America (Chile, Guatemala, Panama, Nicaragua); central–eastern Europe (Albania, Poland, Turkey); central Asia (Tajikistan); sub-Saharan African (Tanzania); west Africa (Niger, Nigeria); and south and east Asia (India, Timor-Leste). These countries cover a wide range of national income levels, from high income (Chile and Poland) to low income (Niger, Tanzania), but exclude OECD countries with the highest income.

Prevalence of consumption and average expenditure on potentially unhealthy products in different socioeconomic groups

Top-to-bottom quintile ratios of consumption prevalence for each of the four aggregates of products are shown in figure 1. Prevalence rates **[A: How can "Prevalence rates include households"? Or should it be ratios instead of rates?]** include all households with a positive (ie, greater

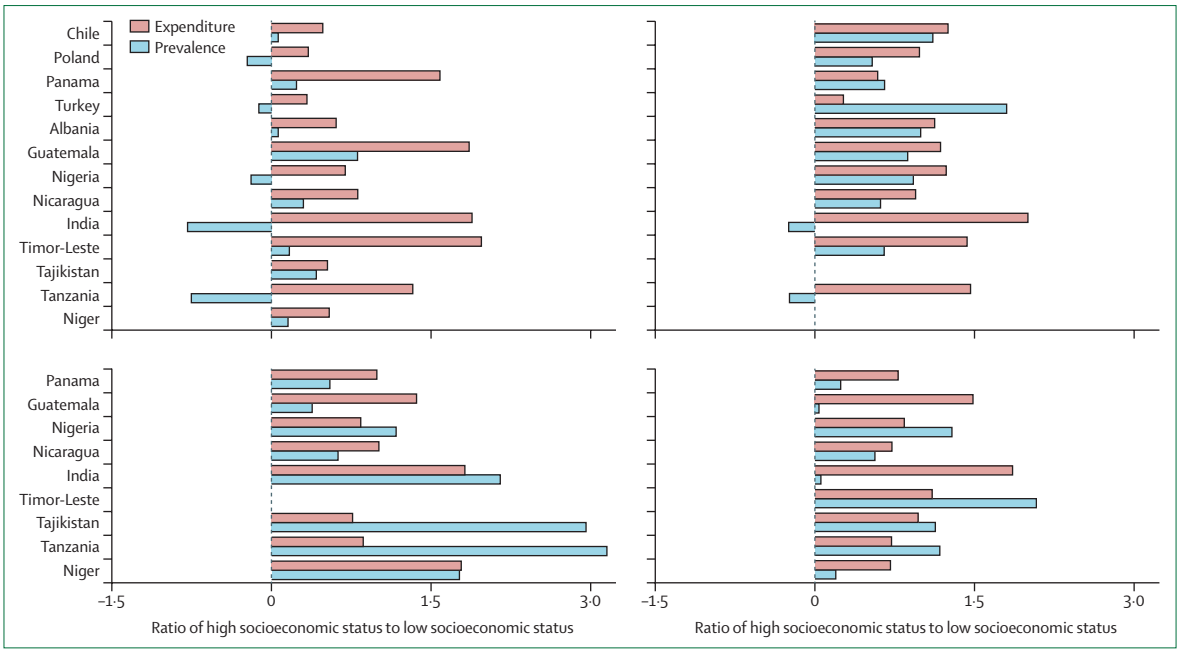

Figure 1: **Socioeconomic disparities in the prevalence of consumption and household expenditure on four product aggregates**
Ratio of household expenditure on or prevalence of consumption of (A) tobacco, (B) alcohol, (C) soft drinks, and (D) snacks in the group with high socioeconomic status (top wealth quintile) over expenditure in the group with low socioeconomic status (bottom quintile) in consumers only. Ratios are calculated after logarithmic transformation of prevalence and expenditure values. Ratios above zero indicate larger prevalence or expenditure in the top wealth quintile; negative ratios indicate larger prevalence or expenditure in the bottom quintile.

than zero) expenditure during the period covered by each survey, using on data from four national surveys (Chile, India, Poland, and Turkey) and from a subset of the Living Standards Measurement Surveys (an international collection of harmonised national household expenditure surveys supported by the World Bank). A parallel set of bars in the same figure shows top-to-bottom quintile ratios of expenditures for the four aggregates of products only for consumers (ie, excluding households that do not consume those products) from the same surveys. Differences in expenditure levels between groups **[A: socioeconomic groups?]** might reflect not only different levels of consumption but also different price levels paid by different groups of consumers (eg, because they consume a more or less expensive mix of products within the relevant aggregate). The latter differences are likely to be small in relatively homogeneous product aggregates (eg, soft drinks), but large in heterogeneous aggregates (eg, alcohol). For example, the higher-income group is likely to consume more expensive types of alcohol than the lower-income group. A larger expenditure resulting from the consumption of expensive products will lead to larger tax payments **[A: than from the consumption of cheaper products?]** only if taxes are proportional to prices (ad valorem).

Tobacco

There is no clear or consistent pattern of prevalence of tobacco use by socioeconomic status in the selected countries (figure 1 A). The clearest gradient of all the countries examined is seen for Guatemala, with people in the top-consumption quintile 2·4 times more likely to use tobacco products than people in the bottom quintile. Individual behaviours cannot be gauged from household expenditure data, but other data sources can shed light on patterns of tobacco use for men and women. For example, data from the Demographic and Health Surveys, which rely on individual self-reports, show a clear inverse relation between socioeconomic status and tobacco use in men in several countries but the opposite pattern in women (including in Albania, where no clear gradient is seen in household-based prevalence data).[18]

By contrast, top-to-bottom quintile ratios of tobacco expenditure (figure 1 A) show consistent gradients across countries, with significantly larger **[A: is this statistically significant, or do you mean substantially larger?]** expenditures by wealthy households **[A: than by poor households?]**. In absolute terms, the wealthiest a larger burden will be borne by the wealthiest households because of their large expenditures on tobacco products (more than six times larger than that of low-income households in countries like India, Timor-Leste, and Guatemala).

Alcohol

Socioeconomic patterns are clear for alcohol use (figure 1 B). High socioeconomic status is associated with a high prevalence of alcohol use in most countries in our analyses (with India and Tanzania displaying a gradient in the opposite direction, and Nicaragua showing no consistent gradient). Data from household

expenditure surveys do not necessarily reflect the patterns of drinking that put people most at risk, such as binge drinking and regular heavy drinking. Other data sources indicate that harmful drinking is most common in men of low socioeconomic status and in women of high socioeconomic status, at least in many OECD countries.[19] The gradient in average expenditure on alcohol is substantially steeper [A: could we add a comparator, eg "than for tobacco"?], with the wealthiest households spending larger amounts than households at the bottom of the socioeconomic scale (in Timor Leste and Tanzania, the wealthiest households spend more than four times more than the poorest households; in India, the wealthiest households spend more than seven times more than the poorest households). On the basis of these findings, policies aimed at increasing the prices of alcoholic beverages will affect fewer poor households than rich households, and the economic burden, in absolute terms, will fall disproportionately on those people who are financially better off, although heterogeneity in patterns of consumption means that some poor households might still bear a large financial burden.

Soft drinks and snacks

Although data for soft drink consumption are available for fewer countries [A: than for tobacco and alcohol consumption? Please specify the comparator], the patterns for soft drink consumption are similar to those for alcohol (figure 1 C). Both the prevalence of soft drink use and expenditures on those beverages are greatest in the wealthiest households, with somewhat less steep gradients in household expenditure than those observed for alcohol, but with up to three-fold differences between socioeconomic groups in India and Niger. However, the soft drinks aggregate is broad and includes different types of beverages (eg, with added sugar, with naturally occurring sugars, and with artificial sweeteners), potentially with different patterns of use by socioeconomic group, and some of these [A: these groups?] might not be the targets of price policies. Patterns are less clear for snacks (figure 1 D), but expenditure gradients are consistent with those seen for soft drinks, with largest expenditures by the wealthiest households. Again, the largest difference between socioeconomic groups is in India (more than three-fold).

Patterns by socioeconomic group vary between countries, but without a clear correlation with income or geography (figure 1). Other country characteristics, presumably associated with national culture and traditions, seem to have a more important role.

Distribution of the health outcomes of price policies

The data examined so far show the shares of households whose consumption would be affected by price policies. However, the effects of price policies on health are determined, above all, by the degree to which consumers respond to price changes (referred to, in economic terms, as price elasticity of demand) and by the substitutions that consumers might make in response to changes in the prices of the products they purchase. Evidence of consumer responses to price changes is not available in all countries and for all products. In this section, we summarise findings from relevant existing studies.

For most of the products targeted by taxation or price regulation, the proportionate change in consumption to be expected is generally less than the proportionate change in price caused by the policy (so-called inelastic demand). For some products (eg, sugar-sweetened beverages[11]) and some population groups (eg, young smokers), the change in consumption was proportionately larger than the change in price [A: text added for clarity. Is this the correct comparator?]. An inelastic demand that is partly due to addiction (at least in the case of tobacco and alcohol products) tends to be associated with limited substitutions by consumers, a high likelihood of the tax being passed on to consumers (as opposed to being absorbed by suppliers), and large revenues for government. An inelastic demand also means that a price intervention has to be relatively large to elicit a response that might lead to meaningful health gains.

Most importantly, for the purposes of this Series paper, the size of consumer responses to price changes is a strong indicator of potential health gains, and different responses by people in different socioeconomic groups mean that a price policy could affect the distribution of health gains across socioeconomic groups. For example, a large response in groups with low socioeconomic status, which is often due to relatively tight budget constraints, is also an indicator of greater health improvements in the poor. Yet other factors come into play as well because health outcomes will also depend on initial consumption levels and the degrees of risk associated with them.

Tobacco

The demand for tobacco products in low-income and middle-income countries (LMICs) is at least as responsive, and often more responsive, to price as it is in high-income countries,[20] with some study findings suggesting the demand in LMICs could be twice as responsive as in high-income countries.[21]

Within countries, evidence suggests that young and low-income consumers have the strongest response to price changes, although evidence of a socioeconomic gradient in price elasticity is less consistent in LMICs.[20,21] In China, estimates suggest that the response is five times larger in the bottom income quintile than in the top quintile, and twice as large in people younger than 24 years than in people aged 65 years or older.[22] In Bangladesh, on the basis of a three-level income classification, the response to price changes is at least two titmes stronger in low-

income cigarette smokers than in high-income smokers.[23] In both countries, the socioeconomic gradient in consumer responses to price changes is largely due to different changes in smoking participation, with virtually no gradient in demand reductions by those who continue to smoke.[23,24]

Alcohol

Consistent evidence suggests that increases in the prices of alcoholic beverages reduce alcohol consumption.[25–28] The response of alcohol drinkers to price changes were similar in countries at all levels of income.[29] Despite a widespread belief that the response to price changes is stronger in low-income drinkers than in high-income drinkers (and at least some evidence to support this[30]), empirical assessments of the size of a possible socioeconomic gradient in the response and of how the gradient might vary between countries at different levels of income and development remain limited.[31] The response to the possible introduction of a minimum price for alcohol in the UK was estimated to be 7·6 times larger in drinkers in the lowest-income quintile than in drinkers in the highest-income quintile.[32]

Food and non-alcoholic beverages

Data on the effect on consumption or sales of relevant food prices have been synthesised in a large number of systematic or structured reviews.[12,33–39] Few comprehensive reviews include data from LMICs. Green and colleagues[38] used evidence from 136 studies and 3495 estimates to characterise consumer responses as changes in their consumption of the products with changed prices (so-called own-price elasticity). Cornelsen and colleagues[39] used data from 78 studies and 4162 estimates to examine the much less frequently assessed substitutions that might occur as a result of price changes (so-called cross-price elasticities). Nakhimovsky and colleagues[40] focused on own-price elasticity of sugar-sweetened beverages in middle-income countries.

Increases in the prices of food and non-alcoholic beverages elicit the greatest changes in consumption in low-income countries, whereas the smallest changes are seen in high-income countries. Within countries, price elasticities for different food and beverage products are higher in lowest-income groups than in highest-income groups, but differences are relatively small, with a response by lowest-income consumers that is 1·14–1·21 times larger than that of highest-income consumers. The data on within-country differences, however, is predominantly from studies of high-income countries (limited to 21 studies at present).[38] Results are similar for sugar-sweetened beverages, with greatest or similar benefits accruing to people of low socioeconomic status in middle-income[40] and high-income countries.[41] Tax on sugar-sweetened beverages was recently introduced in Mexico, and the response of low-income consumers is described in panel 1.

Additional factors affecting the health impacts of price policies

The evidence presented in this section points to a larger reduction in consumption in people of low socioeconomic status than in people of high socioeconomic status, which will probably result in largest health gains for the former group if benefits are not offset by unhealthy substitutions. This partly depends on the respective initial levels of consumption and risk. This social gradient is especially steep for tobacco in high-income countries and is less consistent in LMICs. Similar gradients also exist in consumer responses to changes in alcohol prices, although empirical evidence of these is limited, and in consumer responses to changes in food and non-alcoholic beverage price, but the gradients are substantially smaller in the latter case. The size and type of substitutions that consumers will make is to a large extent the result of how price policies are designed and how the tax base is defined (ie, what products are targeted), and evidence that substitution patterns differ between socioeconomic groups is very limited at present.

Although health gains for individual consumers can be expected to be larger in groups with low socioeconomic status than in groups with high socioeconomic status, aggregate health gains for whole groups might not have the same distribution. This is because the prevalence of consumption differs between socioeconomic groups, which is especially significant **[A: by significant, do you mean "large" or "important"? And is it the prevalence that is significant, or the difference between the groups? Our style is to only use "significant" when referring to statistical significance.]** in the case of alcohol. However, additional factors might contribute to determining aggregate health outcomes in different socioeconomic groups; examples include differences in patterns of consumption and the degrees of risk associated with them, access to care, and concurrent exposures (eg, environmental factors). The long-term outcomes of price policies are therefore best estimated through mathematical models. A recent example is the Chronic Disease Prevention model developed by OECD and WHO, which estimated that a package of fiscal policies including taxation of foods high in fat and subsidies on fruit and vegetables would lead to larger aggregate health gains in people of low socioeconomic status than in people of high socioeconomic status.[5,46]

Financial effects of price policies in different socioeconomic groups

Governments' concerns about the potentially regressive financial effects of price policies for health promotion have been one of the main barriers to a wider use of such policies. However, in addition to its **[A: by "its", are you referring to price policies?]** generic association with a larger financial burden placed on low-income individuals or households, the meaning of regressive in the public debate is not always clear or consistent. In the case of

Panel 1: Mexico's sugar-sweetened beverage tax: the largest response is by low-income consumers

Mexico's obesity and diabetes **[A: type 2 diabetes or all diabetes?]** problems are among the most serious in large countries. The burden is particularly large on lower-income Mexicans who are much less likely to be diagnosed and successfully treated for their diabetes **[A: type 2?]**. On the basis of these health concerns, the Mexican Government implemented an excise tax of 1 peso per L sugar-sweetened beverage (approximately 10% of the price), in Jan 1, 2014, with an inflation adjustment once inflation was at 10% or more.

In the period leading up to the institution of this tax, there was a large battle between the beverage sector and a coalition of Mexican consumer federations advocating the tax and funded mainly by grants from Bloomberg Philanthropies. Public opinion emerged as strongly in favour of taxing sugar-sweetened beverages, and the President backed the proposal.

Researchers estimated changes in household purchases of beverages in 2014 compared with 2012 and 2013. Longitudinal fixed-effects models that examined the difference in trends before and after the tax (difference in differences model) were to account for a pre-existing decrease in purchases of sugar-sweetened beverages over the 2-year period before the tax, using household socioeconomic status and composition and contextual controls for changing economic conditions (city-level unemployment and salary levels).

Beverage purchases collected biweekly from a panel of urban households between 2012 and 2015 provided the panel data. Results of price research showed the full amount of the tax (or more) was passed through to consumers for smaller bottle sizes but not always for larger ones.[42] Pass-through was also lower in poor rural areas **[A: than in rich urban areas? Please state the comparator]**.

In 2014, purchases of taxed beverages decreased by an overall average of 6%, reaching a 12% reduction by December, 2014.[43] This translates to an average of 4·2 L less sugar-sweetened beverage purchased per person in 2014. The tax had the greatest effect on households with low socioeconomic status, with a 9% average decrease in purchases of sugary drinks in 2014 and a 17% decrease by December, 2014. The top socioeconomic tertile did not reduce purchases of sugar-sweetened beverages substantially. Furthermore, the purchase of untaxed beverages increased by 4% overall, which was primarily driven by an increase in bottled water purchases. This suggests that consumers are substituting healthier beverages in place of sugar-sweetened beverages, which translates to about 12·8 L additional water purchased **[A: per person?]**. Concurrent with the tax, beverage companies used a vast array of promotions (eg, free food with purchases of sugar-sweetened beverages), but these appear to have had little effect.

In longitudinal analyses of both first and second year comparisons with the 2012–13 baseline, purchases decreased by an additional 4% beyond the decrease in purchases in the first year, with the greatest change in the poorest households (overall –9·0% in 2014 and –14·3% in 2015).[44] This result was replicated in an analysis of national sales per capita data.[45]

The 1-year tax effect is moderate but important, particularly for the population with the lowest socioeconomic status. This group paid much less tax because it purchased substantially fewer sugar-sweetened beverages. This group was most likely to increase water purchases. Part of the revenues is being used to provide potable water to public schools mainly for children in lower-income and middle-income populations. It will take a number of years of this tax before the reduction in sugar consumption will create visible health improvements, but this econometric analysis of directly measured transactions of all food and beverage purchases shows promise that the tax will differentially improve the diet and, ultimately, the health of Mexicans of low socioeconomic status.

taxes, for example, the most common measure of financial burden in a given socioeconomic group is the average ratio between taxes paid and ability to pay (commonly proxied by income or disposable income, but also by total household expenditure) across all households in that group. This measure does not take into account the positive financial effects of taxes through the health improvements they might generate. Also, this tax burden measure is heavily influenced by the proportion of households that consume the taxed product in each group, such that the tax burden will be lowest in groups in which fewest households consume the product. Reducing the prevalence of consumption is a goal of price policies for health promotion, so it is important to account for prevalence reduction as a factor that helps to contain the burden of taxation (or price policies more generally) in a given socioeconomic group. The main limitation of a burden measure encompassing all households is that it does not reflect the real burden borne by households whose members consume the product. To determine this, households that do not consume the product in question should be excluded from group averages, which we have done in the calculation of a second measure of the financial burden of price policies (referred to as consumers only), shown alongside whole-group averages. We rely again on household expenditure survey data from the countries previously examined.

A further important distinction is between the distribution of the burden of a price policy and the distribution of the burden caused by a change in an existing policy. Tobacco and alcohol taxes, for example, are almost universal, and the relevant policy question is not whether these products should be taxed but whether existing taxes should be increased. A tax can be regressive, yet an increase in the same tax might attenuate its regressive effect if the response by low-income households

Panel 2: Simulating the distributional effects of a hypothetical increase in the prices of tobacco through taxation in Lebanon

Lebanon has the health and tobacco consumption profile typical of many middle-income countries: non-communicable disease is the number one cause of death, with ischaemic heart disease alone accounting for more than 30% of deaths.[47] The smoking prevalence, at 43% for men and 28% for women, is one of the highest in the Middle East.[48] Smoking intensity in Lebanon is also three times the world average and increased by 475% between 1990 and 2012.[49] Unlike many high-income countries, where taxes are almost two-thirds of tobacco retail price, the share of taxes in price is closer to 47% in Lebanon. Estimated demand elasticities for different tobacco products imply that increasing taxes has the potential to generate substantial additional tax revenue.[50]

We simulated the distributional consequences of a potential increase in tobacco taxes (table). We used an Almost Ideal Demand System[51] to estimate the elasticities of demand for imported cigarettes by quintile; as in the study by Salti and colleagues,[52] we simulated the financial consequences of increased tobacco prices for each quintile by running an extended cost-effectiveness analysis.[53] The outcomes of this analysis is based on the consumption of imported cigarettes because their share of total spending on all tobacco products in Lebanon is close to 90%. Before a tax increase, the unconditional tax burden was only progressive, moving from the poorest to the second quintile, regressive thereafter. The conditional tax burden showed progressivity from the poorest to the middle quintile. After a tax increase, higher cigarette prices led some smokers to quit and others to reduce their smoking intensity. The largest relative (and absolute) reductions in consumption from quitting were in the poorest quintile and the smallest reductions in the richest quintile. We report only the quitting rates, but the drop in intensity follows the same pattern across quintiles. These findings indicate that more of the health gains from lower consumption accrue to poorer quintiles.

The additional tax revenue was financed primarily by the richer quintiles (31%), with only 7% of the additional taxes collected from the poorest quintile. However, as a fraction of total household expenditures, the additional taxes paid were a larger share of total spending for the second and middle quintiles.

Similarly, the additional expenditures on tobacco products resulting from the increase in taxes were financed primarily by the richer quintiles (34%). However, these additional financial outlays represented a larger share of household expenditures for the second and middle quintiles, and a smaller share for the poorest and the top two quintiles. When we restricted our analysis to smokers, the financial burden of higher spending on tobacco increased as we moved from the poorest to the middle quintile, and decreased slightly for the fourth and richest quintiles. However, smokers in the poorest quintile bore a considerably smaller burden than patients in the top quintiles.

In the context of a middle-income country like Lebanon with a heavy burden of tobacco-related disease, there are substantial health and financial benefits to increasing taxes on tobacco, which do not systematically come at the cost of more disadvantaged socioeconomic groups. Rather, such fiscal measures can curb risky behaviour and generate tax revenue while making the overall tobacco tax structure relatively more progressive.

were sufficiently larger than that of high-income households. A weak response (typical of high-income groups) is associated with a large increase in expenditure on a taxed product (and therefore a large increase in tax paid). This is illustrated using the example of a tobacco tax hike in Lebanon (panel 2). These are average effects, summarising individual situations that range from a reduced tax burden for those who stop consuming the taxed product to an increased burden for those who are least responsive to price changes.

As an extension of research by the OECD on the effects of consumption taxes in different socioeconomic groups,[59] we present estimates of the distribution of the burden of excise taxes on alcohol and tobacco in three OECD countries (Chile, Poland, and Turkey), selected as the lowest-income countries in the OECD study (based on gross-domestic product per capita), for which data were available; Poland and Turkey are also part of a group of 23 countries with high burdens of NCDs (figure 2).[60] The tax burden in these countries is measured as a ratio between tax expenditure and total household expenditure. However, the numerator of this measure is not available for other LMICs examined in this Series paper. For the latter, we present distributions of the proportion of household expenditure on tobacco, alcohol, soft drinks, and snacks, which is a proxy of tax burden.

Tobacco

In Chile, Poland, and Turkey, the two measures of tax burden (all households and consumers only) lead to similar conclusions about the distribution of the burden of tobacco taxation because differences in the prevalence of consumption between socioeconomic groups are very small (prevalence increases slightly with income in Chile and decreases slightly [A: with income] in Poland and Turkey). In all three countries, the burden from tobacco taxes is roughly three times larger in the bottom-income quintile than in the top-income quintile.

Alcohol

The distribution of tax burden is very different for alcohol (figure 2 B) because of the significantly larger [A: statistically significant?] prevalence of alcohol use in groups with high socioeconomic status than in groups with low socioeconomic status. The burden of alcohol excise taxes averaged across all households in each quintile is progressive in all three countries, with households in the top-income quintile bearing a burden

	Q1 (poorest)	Q2	Q3	Q4	Q5 (richest)	Total
Before the tax increase						
Total spending on imported cigarettes (in US$ millions)	58	121	159	184	216	738
Taxes paid as percentage of household spending (unconditional)	1·9%	2·5%	2·4%	2·0%	1·7%	2·0%
Number of smokers (in thousands)	217	221	213	194	176	1210
Taxes paid as percentage of household spending for smokers (conditional)	6·9%	8·8%	8·8%	8·0%	7·6%	8·1%
After the tax increase						
Number of quitters as a result of tax increase (in thousands)	20·2	17·4	16·1	13·6	11·3	78·5
Percentage of smokers who quit	9·0%	8·0%	7·5%	7·0%	6·4%	7·7%
Increased tax revenue (in US$ millions)	45	9	129	150	179	600
Percentage of increased tax revenue borne by quintile	7·0%	16·0%	21·0%	25·0%	31·0%	100·0%
Increased tax revenue as percentage of pretax increase household exp **[A1]**	1·6%	2·2%	2·1%	1·8%	1·6%	1·8%
Increased tax revenue as percentage of pretax increase household exp **[A1]** for smokers (conditional)	6·4%	8·4%	8·6%	8·0%	7·7%	7·7%
Increased tobacco expenditures by households (in US$ millions)	14	36	49	59	74	232
Percentage of total increase in expenditures on tobacco by quintile	24·0%	30·0%	31·0%	32·0%	34·0%	31·0%
Additional tobacco expenditures by households as percentage of household expenditures (unconditional)	1·1%	1·7%	1·7%	1·5%	1·3%	1·5%
Additional tobacco expenditures by households as percentage of household expenditures for smokers (conditional)	4·7%	6·8%	6·9%	6·6%	6·5%	6·3%

[A1: what does 'exp' mean?] Spending data are from the nationally representative multipurpose survey of household living conditions in Lebanon, collected in 2004.[54] Import data are from the National Customs Authority of Lebanon,[55] and tax revenue calculations are based on Ministry of Finance documentation on the tax structure of cigarettes.[56] Simulations are based on estimated elasticities of demand for imported cigarettes by quintile (authors' calculation by applying an Almost Ideal Demand System[51] model to household expenditure data from the same survey). Half of the elasticity is assumed to be from participation and the other half from intensity.[57] Prevalence data is from the Institute for Health Metrics and Evaluation, and demographic data are from the Ministry of Public Health of Lebanon.[58] Conditional figures were calculated assuming that smokers are uniformly distributed across household expenditures within each quintile.

Table: **The simulated consequences of a 50% increase in the price of cigarettes by taxes, tobacco finances, and smoking behaviour**

between 1·6 (Chile) and 2·8 (Turkey) times larger than by households in the bottom-income quintile. However, the tax burden borne by households that do consume alcohol is very slightly regressive in Chile and Poland and more steeply regressive in Turkey, where the burden is 2·4 times larger in the bottom-income quintile than in the top-income quintile. This means that the burden of alcohol taxes is borne disproportionately by higher-income groups, but the financial burden borne by individual low-income households consuming alcohol is proportionately larger than that that borne by high-income households consuming alcohol. This is consistent with the findings of a UK study, which showed a progressive pattern for a 5% increase in alcohol prices, in terms of average effects across all households, and a regressive pattern when the denominator included only households consuming alcohol.[61]

The share of total household expenditure spent on the four product categories in different socioeconomic groups is shown in figure 3. Tobacco products (figure 3 A) account for a larger proportion of expenditure in low-income households than in high-income households, with few exceptions (Tajikistan, Timor-Leste, Panama). Averages **[A: Average expenditures?]** across all households and for consumers only are similar in most cases because gradients in the prevalence of tobacco consumption are not steep or consistent in the countries concerned. Conversely, the share of total expenditure spent on alcoholic beverages as an average across all households in each socioeconomic group is larger in high-income households than in low-income households in all countries except Tanzania, Nicaragua, and Guatemala. However, alcoholic beverages weigh disproportionately on the expenditure of low-income households that consume alcohol in most countries.

Soft drinks and snacks

Average expenditures on soft drinks across all households in each income quintile (figure 3 C), as a share of total expenditure, indicates that price policies would have progressive or neutral effects in most countries and regressive patterns in Guatemala and Nicaragua. The prevalence of consumption is lowest in lower-income quintiles, and the financial burden on consumer households consistently shows a less progressive, or even regressive, distribution. For snacks,

a regressive distribution of expenditure shares averaged across all households is seen in Guatemala, Nicaragua, Panama, and Niger (figure 3 D), whereas the distribution is progressive in the Asian countries and in Tanzania. However, in at least some countries, the income groups bearing the highest potential burden of price policies are those in the central part of the distribution. Because the prevalence of consumption increases with income, the burden on consumer households is more regressive, with a progressive distribution being preserved only in Tajikistan.

In summary, the burden of price increases might well be proportionately large in groups with lowest socioeconomic status in the case of tobacco, and in groups with the highest socioeconomic status in the case of alcohol, soft drinks, and snacks, albeit with exceptions. However, when considering only households that consume these product categories, the burden tends to be highest in groups with the lowest socioeconomic status.

Should governments be concerned about the financial effects of price policies?

The use of price policies by governments for the purpose of improving health has generated a large debate focused on both the benefits and the unintended consequences of such policies. The potential for price policies to have regressive financial effects has been one of the main arguments against the use of price policies, and this argument is often used as part of opposition efforts by industry stakeholders. In this Series paper, we scrutinise existing data that could help governments understand the equity effects of possible price policies on tobacco, alcohol, soft drinks, and snacks. The effects of price policies are not assessed directly in our analyses because not all of the countries considered have relevant price policies in place, and where such policies are in place, the necessary data are not available or accessible. We have instead relied on household expenditure data and information on consumer responsiveness to price changes to gauge the likely distribution of the effects of price policies across socioeconomic groups.

Although it is not possible to draw a simple and generalisable conclusion from the analyses presented here, a number of important findings focused on a selection of LMICs can provide helpful guidance to governments. On the whole, these findings suggest that concerns about adverse equity effects might be outweighed, in many cases, by the expectation of health gains and by a number of pro-poor effects.

Price policies affect more high-income households than low-income households

The first finding is that price policies will affect a larger number of high-income than low-income households, and the absolute increases in expenditure involved will be largest for high-income households. This is because the prevalence of consumption and the expenditure on alcohol, soft drinks, and snacks increase consistently with household income. This is also true for expenditure on tobacco products, although there is no clear and consistent gradient in the prevalence of tobacco use in the countries examined. An important implication of this conclusion is that the additional expenditures caused by policies that increase prices (eg, the revenues generated by taxes) come disproportionately from high-income households. Tax design can influence this effect, and tax policy makers have to consider potential trade-offs. For example, a volumetric tax on alcohol might be more effective in reducing the number of units of alcohol consumed, but an ad-valorem tax (a function of price) would probably shift more of the financial burden onto higher-income consumers.

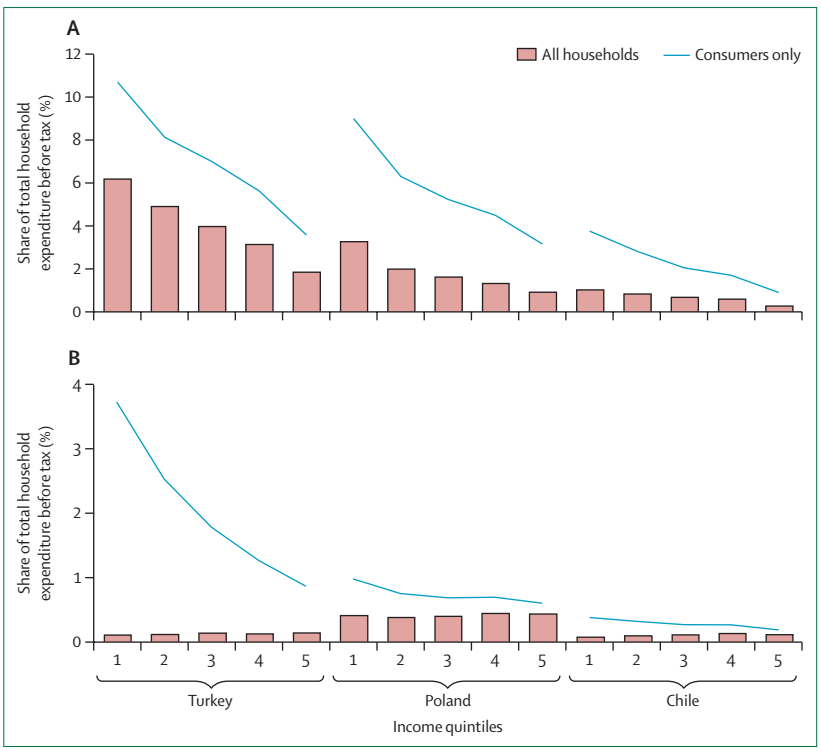

Figure 2: **Tax burden of tax excises in three OECD countries by income quintile**
(A) Tax excises for tobacco. (B) Tax excises for alcohol. Quintiles are ordered from 1 (bottom-income quintile) to 5 (top-wealth quintile). OECD=Organisation for Economic Co-operation and Development.

Low-income households often (not always) bear the largest tax burden

The second finding is about the distribution of the burden of tax policies as a proportion of total household expenditure. Low-income households bear the largest tobacco tax burden consistently across countries. The distribution of the tax burden of alcohol taxes is generally progressive, although the burden borne by just the low-income households that consume alcohol

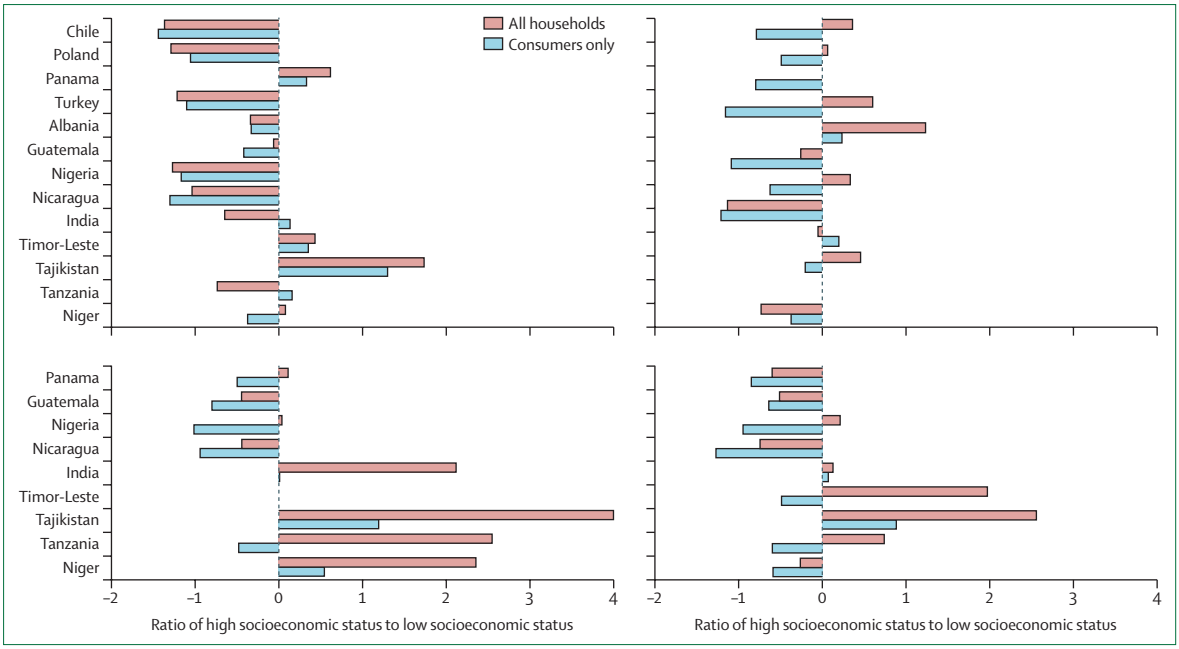

Figure 3: **Socioeconomic disparities in household expenditure on four product categories as a share of total household expenditure**
Ratios of share of expenditure on (A) tobacco, (B) alcohol, (C) soft drinks, and (D) snacks in group with high socioeconomic status (top wealth quintile) over expenditure in the group with low socioeconomic status (bottom quintile). Ratios are calculated after logarithmic transformation of expenditure values. Ratios above zero indicate larger prevalence or expenditure in the top wealth quintile; negative ratios indicate larger prevalence or expenditure in the bottom quintile. The share of expenditure For Chile, Poland, and Turkey is calculated as a proportion of pre-tax expenditure (total household consumption exclusive of excise taxes and VAT).

is proportionately larger than borne by high-income households consuming alcohol. The potential distribution of the burden of price policies targeting soft drinks and snacks varies between countries, but again, the low-income households consuming these products tend to bear the largest financial burden.

Low-income consumers enjoy the largest health benefits

Finally, the health benefits generated by price policies will be largest for low-income consumers because of their strong response to price changes, but governments must design their policies carefully to minimise unhealthy substitutions in consumption (ensuring access to healthy substitutes). At the aggregate level, higher-income groups might still accrue large gains where there is a high prevalence of consumption in these groups.

The data for this Series paper are based mostly on household expenditure surveys and are readily available, but they have a number of limitations, typically resulting from the self-reported nature of expenditure information and from product aggregations. Additionally, the household-based nature of these datasets means that we were not able to identify individual-level patterns, which are important when assessing the potential health effects of price policies and determining the prevalence of consumption associated with increased levels of risk **[A: Edited for additional clarity, but please check. The alternative interpretation was that you were not able to identify individual-level patterns or determine the prevalence of consumption associated with increased levels of risk. Which is correct?]**. The availability and reliability of household expenditure data vary greatly between countries and tend to be best in higher-income countries, but data on consumer responsiveness to price changes and likely substitutions in different socioeconomic groups are even scarcer.

Health effects have financial consequences too

Health effects, in turn, might have financial consequences for the households concerned. For instance, tobacco taxation can reduce the incidence of catastrophic health-care expenditures in low-income households (panel 2). Studies undertaken by the World Bank on tobacco taxation in Armenia[62] and Chile[63] have shown that taxes can increase household net incomes in the long term (by reducing out-of-pocket medical expenses and increasing earnings because of an increase in working years) and prevent catastrophic health expenditures and poverty in low-income populations.

Whatever the measure of equity effect, price policies are never unequivocally regressive

We have shown that the direction and size of the equity effects of price policies depend to a large extent on the measures that are used to assess them and on the specific objectives of government policy. In no case are these effects unequivocally regressive. Additionally, where taxes or tax increases do generate regressive tax burdens, governments should also consider the positive financial

effects linked with health improvements that are triggered by taxation as well as the size of the monetary effects involved. For example, possible taxes on sugar-sweetened beverages in the USA and in Australia were estimated to weigh more heavily on the poor, with relatively steep gradients in terms of share of tax burden on household income. However, the extra tax payments were estimated to be US$4/low-income household per year for a US$0·5/cent per ounce tax in the USA, and up to AU$3·7 AUD for a AU$0·2/L tax in Australia (averages across all households in each income group).[64,65] Of course, no amount of money, however small, is trivial for low-income households, especially in low-income countries, but governments must consider carefully whether the amounts involved represent a barrier to the implementation of a potentially beneficial health policy, from which lower-income people are likely to benefit disproportionately.

Another reason why regressive effects such as those described here and elsewhere should be interpreted cautiously is that at least the most common type of price policy (ie, taxation) generates substantial amounts of government revenues that can be used to mitigate or even offset any unfair distribution of tax burden. Whether or not tax revenues are earmarked (and several important examples of earmarking exist, two of which [Thailand and Philippines] are described in the appendix), the revenues generated will contribute to the growing tax revenue pool that is typically used by governments to deliver public services, of which low-income people might benefit disproportionately.

In China and in India, a 50% increase in tobacco prices would lead to larger decreases in expenditure on tobacco-related diseases, as a share of income, in the bottom-income quintiles than in the top-income quintile, providing financial risk protection to those who have the lowest incomes.[22,66] Jan and colleagues,[67] in the third paper of this Series, provides further examples of how revenues can be used by governments for risk protection. Finally, what governments are, or should be, mostly concerned about is the regressive or progressive nature of their tax system as a whole, not individual tax measures. When Denmark introduced an innovative tax on saturated fat in 2011, it did this as part of a broader tax reform that altered the progressivity of its income tax.[68]

Our analysis provides some clear evidence on numerous effects that countries can expect from price policies on the four aggregates of products examined. However, a final lesson from the analyses is that a detailed assessment is needed in each setting and for each policy because important dimensions of effects cannot be generalised, and uniform patterns cannot always be identified. The social dimensions of consumer behaviours vary between and within countries. Claims that are not based on a detailed analysis of country-specific data are bound to be simplistic and most likely misguided.

Contributors

FS, AB, MS, and RN conceived the study. AM obtained the data and analysed the LSMS data. AT obtained and analysed data for Chile, Poland, and Turkey. SV obtained and analysed data for India. BMP drafted Panel 1, NS drafted Panel 2, CV drafted the focus on earmarking [A: correct?]. All authors contributed to the interpretation of findings and to the writing of the Series paper.

Declaration of interests

FS reports a grant from International Development Research Centre, during the conduct of the study. RN reports grants from Bloomberg Philanthropies and from Cancer Research UK, outside the submitted work. The opinions expressed and arguments used in this paper are solely those of the authors and do not necessarily reflect the official views of the OECD or its member countries.

Acknowledgments

The authors would like to thank Robert Beaglehole, co-ordinator of the Lancet NCD Action Group Series. A grant from the International Development Research Centre funded collaborative travel for all authors of this Series paper [A: is this statement suitable?].

References

1 UN. Political declaration of the high-level meeting of the general assembly on the prevention and control of non-communicable diseases. New York, NY: United Nations, 2011.

2 Di Cesare M, Khang YH, Asaria P,. Inequalities in non-communicable diseases and effective responses. *Lancet* 2013; **381:** 585–97.

3 Asaria P, Chisholm D, Mathers C, Ezzati M, Beaglehole R. Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. *Lancet* 2007; **370:** 2044–53.

4 Abegunde DO, Mathers CD, Adam T, Ortegon M, Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet* 2007; **370:** 1929–38.

5 Sassi F. Obesity and the economics of prevention: fit not fat. Paris: OECD Publishing, 2010.

6 Sassi F. Tackling harmful alcohol use: economics and public health policy. Paris: OECD Publishing, 2015.

7 WHO. WHO framework convention on tobacco control. Geneva: World Health Organization, 2003.

8 WHO. Global strategy to reduce the harmful use of alcohol. Geneva: World Health Organization, 2010.

9 OECD. Obesity update 2012. Paris: OECD Publishing, 2012.

10 OECD. Obesity update 2014. Paris: OECD Publishing, 2014.

11 Powell LM, Chriqui JF, Khan T, Wada R, Chaloupka FJ. Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: a systematic review of prices, demand and body weight outcomes. *Obes Rev* 2013; **14**: 110–28.

12 Stockwell T, Zhao J, Martin G, et al. Minimum alcohol prices and outlet densities in British Columbia, Canada: estimated impacts on alcohol-attributable hospital admissions. *Am J Public Health* 2013; **103:** 2014–20.

13 UN. Report of the third International Conference on Financing for Development, Addis Ababa, 13-16 July, 2015. New York, NY: United Nations, 2015.

14 Stenberg K, Elovainio R, Chisholm D, et al. Responding to the challenge of resource mobilization- mechanisms for raising additional domestic resources for health. World Health Report 2010. Background Paper, 13. Geneva: World Health Organization, 2010.

15 Sassi F, Hurst J. The prevention of lifestyle-related chronic diseases: an economic framework. OECD Health working paper number 32. Paris: OECD Publishing, 2008.

16 Suhrcke M, Nugent RA, Stuckler A, Rocco L. Chronic disease: an economic perspective. London: Oxford Health Alliance, 2006.

17 Cawley J, Frisvold D. The incidence of taxes on sugar-sweetened beverages: the case of Berkeley, California. NBER working paper number 21465. Cambridge, MA: National Bureau of Economic Research, 2015.

18 Sreeramareddy CT, Pradhan PMS. Prevalence and social determinants of smoking in 15 countries from north Africa, central and western Asia, Latin America and Caribbean: secondary data analyses of demographic and health surveys. *PLoS One* 2015; **10:** e0130104.

19 Devaux M, Sassi F. Alcohol consumption and harmful drinking: trends and social disparities across OECD countries. OECD Health working paper number 79. Paris: OECD Publishing, 2015.

20 Chaloupka FJ, Yurekli A, Fong GT. Tobacco taxes as a tobacco control strategy. *Tob Control* 2012; **21:** 172–80.

21 Levy DT, Chaloupka FJ, Gitchell J. The effects of tobacco control policies on smoking rates: a tobacco control scorecard. *J Public Health Manag Pract* 2004; **10:** 338–53.

22 Verguet S, Gauvreau CL, Mishra S, et al. The consequences of tobacco tax on household health and finances in rich and poor smokers in China: an extended cost-effectiveness analysis. *Lancet Glob Health* 2015; **3:** e206–16.

23 Nargis N, Ruthbah UH, Hussain AK, Fong GT, Huq I, Ashiquzzaman SM. The price sensitivity of cigarette consumption in Bangladesh: evidence from the International Tobacco Control (ITC) Bangladesh Wave 1 (2009) and Wave 2 (2010) Surveys. *Tob Control* 2014; **23** (suppl 1): i39–47.

24 Huang J, Zheng R, Chaloupka FJ, Fong GT, Jiang Y. Differential responsiveness to cigarette price by education and income among adult urban Chinese smokers: findings from the ITC China Survey. *Tob Control* 2015; **24:** iii76–82.

25 Wagenaar AC, Salois MJ, Komro KA. Effects of beverage alcohol price and tax levels on drinking: a meta-analysis of 1003 estimates from 112 studies. *Addiction* 2009; **104:** 179–90.

26 Fogarty J. The demand for beer, wine and spirits: insights from a meta-analysis approach. AAWE working paper number 31. New York, NY: American Association of Wine Economists, 2008.

27 Gallet CA. The demand for alcohol: a meta-analysis of elasticities. *Aus J Agric Res Econ* 2007; **51:** 121–35.

28 Nelson JP. Meta-analysis of alcohol price and income elasticities—with corrections for publication bias. *Health Econ Rev* 2013; **3:** 17.

29 Sornpaisarn B. Shield K, Cohen J et al. Elasticity of alcohol consumption, alcohol-related harms, and drinking initiation in low-and middle-income countries: a systematic review and meta-analysis. *Int J Drug Alcohol Res* 2013; **2:** 1–14.

30 Ayyagari P, Deb P, Fletcher J, Gallo W, Sindelar JL. Understanding heterogeneity in price elasticities in the demand for alcohol for older individuals. *Health Econ* 2013; **22:** 89–105.

31 The Alcohol and Public Policy Group. Alcohol, no ordinary commodity: research and public policy. Oxford: Oxford University Press, 2010.

32 Holmes J, Meng Y, Meier PS, et al. Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: a modelling study. *Lancet* 2014; **383:** 1655–64.

33 Hawkes C. Financial incentives and disincentives to encourage healthy eating. London: Which?, 2009.

34 Eyles H, Ni Mhurchu C, Nghiem N, Blakely T. Food pricing strategies, population diets, and non-communicable disease: a systematic review of simulation studies. *PLoS Med* 2012; **9:** e1001353.

35 Thow AM, Jan S, Leeder S, Swinburn B. The effect of fiscal policy on diet, obesity and chronic disease: a systematic review. *Bull World Health Organ* 2010; **88:** 609–14.

36 Shemilt I, Hollands GJ, Marteau TM, et al. Economic instruments for population diet and physical activity behaviour change: a systematic scoping review. *PLoS One* 2013; **8:** e75070.

37 Shemilt I, Marteau TM, Smith RD, Ogilvie D. Use and cumulation of evidence from modelling studies to inform policy on food taxes and subsidies: biting off more than we can chew? *BMC Public Health* 2015; **15:** 297.

38 Green R, Cornelsen L, Dangour AD, et al. The effect of rising food prices on food consumption: systematic review with meta-regression. *BMJ* 2013; **346:** f3703.

39 Cornelsen L, Green R, Turner R, et al. What happens to patterns of food consumption when food prices change? Evidence from a systematic review and meta-analysis of food price elasticities globally. *Health Econ* 2015: **24:** 1548–59.

40 Nakhimovsky SS, Feigl AB, Avila C, O'Sullivan G, Macgregor-Skinner E, Spranca M. Taxes on sugar-sweetened beverages to reduce overweight and obesity in middle-income countries: a systematic review. *PLoS One* 2016; **11:** e0163358.

41 Backholer K, Sarink D, Beauchamp A, et al. The impact of a tax on sugar-sweetened beverages according to socio-economic position: a systematic review of the evidence. *Public Health Nutr* 2016; **19:** 3070–84.

42 Colchero MA, Salgado JC, Unar-Munguía M, Molina M, Ng S, Rivera-Dommarco JA. Changes in prices after an excise tax to sweetened sugar beverages was implemented in Mexico: evidence from urban areas. *PLoS One* 2015; **10:** e0144408.

43 Colchero MA, Popkin BM, Rivera JA, Ng SW. Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. *BMJ* 2016; **352:** h6704.

44 Colchero MA, Rivera-Dommarco J, Popkin BM, Ng SW. In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax. *Health Affairs* 2017; **36:** 564–71.

45 Colchero M, Guerrero-López CM, Molina M, Rivera JA. Beverages sales in Mexico before and after implementation of a sugar sweetened beverage tax. *PLoS One* 2016; **11:** e0163463.

46 Cecchini M, Sassi F, Lauer JA, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and cost-effectiveness. *Lancet* 2010; **376:** 1775–84.

47 Institute for Health Metrics and Evaluation. Global burden of disease. http://www.healthdata.org/gbd (accessed Sept XX, 2013) **[A: I have added in a URL – please check and confirm that this is a suitable URL. Please also indicate your access date]**.

48 Salti N, Chaaban J, Naamani N. The economics of tobacco in Lebanon: an estimation of the social costs of tobacco consumption. *Subst Use Misuse* 2014; **49:** 735–42.

49 Chakrani H. Smoking: 2379 cigarettes per capita in Lebanon. *Al-Akhbar English*, June 10, 2013. http://english.al-akhbar.com/node/16064 (accessed May 29, 2015).

50 Salti N, Chaaban J, Nakkash R, Alaouie H. The effect of tobacco taxation on tobacco consumption and public revenues in Lebanon. *Tob Control* 2015; **24:** 77–81.

51 Deaton A, Muellbauer J. An almost ideal demand system. *Am Econ Rev* 1980; **70:** 312–26.

52 Salti N, Brouwer E, Verguet S. The health, financial and distributional consequences of increases in the tobacco excise tax among smokers in Lebanon. *Soc Sci Med* 2016; **170:** 161–69.

53 Verguet S, Laxminarayan RL, Jamison DT. Universal public finance of tuberculosis treatment in India: an extended cost-effectiveness analysis. *Health Econ* 2015; **24:** 318–32.

54 The Lebanese Central Administration of Statistics. National living conditions of households survey 2004. http://www.cas.gov.lb/index.php/all-publications-en#households-living-conditions-survey-2004 (accessed June 21, 2015).

55 National Customs Authority of Lebanon. Data on imports of tobacco 1997–2011. Beirut, Lebanon: National Customs Authority, 2012.

56 Mahdi, B., 2014, presentation on "Simulating an increase in tobacco taxes," Ministry of Public Health, the Framework Convention Alliance and Green Hand conference on tobacco taxation in Lebanon, October 29, 2014, Beirut, Lebanon.

57 Chaloupka FJ, Grossman M. Price, tobacco control policies and youth smoking. NBER working paper number 5740. Cambridge, MA: National Bureau of Economic Research, 1996.

58 Ministry of Public Health of Lebanon. Statistical bulletin, 2011. http://www.moph.gov.lb/Publications/Documents/Statistical%20Bulletin%202011.pdf (accessed July 17, 2015).

59 OECD/Korea Institute of Public Finance. The distributional effects of consumption taxes in OECD countries. OECD tax policy studies number 22. Paris: OECD Publishing, 2014.

60 Beaglehole R, Ebrahim S, Reddy S, et al. Prevention of chronic diseases: a call to action. *Lancet* 2007; **370:** 2152–57.

61 Leicester A. Alcohol pricing and taxation policies. IFS Briefing Note BN124. London: Institute for Fiscal Studies, 2011.

62 Postolovska I, Lavado RF, Tarr G, Verguet S. Estimating the distributional impact of increasing taxes on tobacco products in armenia : results from an extended cost-effectiveness analysis. Washington, DC: World Bank, 2017.

63 Fuchs A, Meneses F. Are tobacco taxes really regressive? Evidence from Chile. Washington, DC: World Bank, 2017.

64 Zhen C, Finkelstein EA, Nonnemaker J, Karns S, Todd JE. Predicting the effects of sugar-sweetened beverage taxes on food and beverage demand in a large demand system. *Amer J Agr Econ* 2013; **96:** 1–25.

65 Sharma A, Hauck K, Hollingsworth B, Siciliani L. The effects of taxing sugar-sweetened beverages across different income groups. *Health Econ* 2014; **23:** 1159–84.

66 Murphy S, Verguet S, Nugent R. Tobacco taxation in India: an extended cost effectiveness analysis. Department of Global Health, University of Washington. Available at: http://www.nisi.kg/uploads/research_ph/research_2015/2_India%20-%20Extended%20Cost%20Effectiveness%20Analysis%20of%20Tobacco%20Taxation.pdf. **[A: I am unable to find the paper online, so please check these reference details]**

67 Jan S, Laba T-L, Essue B, et al. Action to address the household economic burden of non-communicable diseases. *Lancet* 2018; **[To be completed by Editor]**

68 Danish Ministry of Taxation. Danish tax reform 2010. Copenhagen: Danish Ministry of taxation, 2009.